

Sugar for wounds

John Topham

Pharmacist, rtd.

Sugar in its pure form, or incorporated into a paste containing an adhesive hydropolymer (gum), is a non-toxic treatment for a variety of wounds. Not only does it provide a suitable clean environment for angiogenesis to take place, but it will debride the wound surface and reduce odour. The presence of an adhesive hydro-polymer seems to prevent hypergranulation, scarring and contraction.

Introduction

Sugar is the disaccharide of sucrose; it will combine with other polar substances (such as water) by hydrogen bonding¹. Both granulated and caster sugar can be applied to wounds as pure substances or combined with water and other materials in sugar pastes. Icing sugar is the powdered form of sugar and contains an anticaking agent to reduce moisture adsorption. Honey is also used to treat wounds² but has the tendency to seep out of the edges of dressings covering them³. This can be prevented by the use of dressings soaked in honey or by the addition of hypromellose to honey. Most of this article will be restricted to the wound healing properties of sugar and sugar pastes.

It is known that optimal rates of healing of deep cavity wounds will take place in a clean environment, at the wound surface, which aids the normal moist healing process⁴. In order to achieve this, the wound cavity may be filled with a material which encourages angiogenesis, such as foam, or the moisture absorbing materials alginates, hydrocolloids, hydrogels, honey and sucrose⁵. Under these conditions the complete range of wound healing processes described by Clark and Henson⁶ can take place.

Wound Healing Properties of Sugar

The beneficial properties of sucrose are considered to be:

- lack of toxicity;
- production of a clean environment by sterilization and debridement;
- encouragement of angiogenesis;
- reduction of wound odour.

To these can be added:

- prevention of overgranulation;
- prevention of contraction and scarring,

when sugar pastes containing gums are used.

Toxicity

The classic paper by Chirife et al⁷ demonstrated that granulated sugar is non toxic, even when applied to the wounds of diabetic patients. Others have reported similar findings⁸⁻¹⁴. Since sucrose is excreted through the kidneys, it should be used with caution in patients with renal disease. Both caster and granulated sugar can be applied to open wounds because they are pure sucrose and do not contain additives. Icing sugar contains an anticaking agent, such as sodium aluminium silicate, which may be irritant to some wounds, even though it has been applied to superficial wounds with considerable success^{3,15}.

Sterility

Sugar has been used on wounds for more than two centuries¹¹. Pure sugar will produce a sterile environment at the wound surface, because its water activity (ie the ratio of vapour pressure produced by sugar to the vapour pressure of pure water) is very low^{16,17}. In other words, the removal of water prevents bacteria from multiplying and, in some cases, kills them. Chirife et al⁷ took a slightly different view and suggested that bacteria in the wound cavity containing sugar are subjected to a series of 'osmotic shocks' causing injury and death.

It seems that, as exudate combines with the sugar by hydrogen bonding¹, the water activity of the sugar at the wound surface rises, producing a moist environment for angiogenesis to take place¹⁸. Even though the concentration of sucrose at the wound surface is greatly reduced by exudate, it should be possible for a protective layer of partially diluted sugar to exist above the greatly diluted sucrose, thereby ensuring continuing sterility at the wound surface. This would enable the wound healing process to continue, in fact Archer et al¹⁹ stated that 'wounds healed satisfactorily without the need for sterility'. This idea is reinforced by the findings of Cooper et al²⁰ who showed that the sugars in honeys could be diluted as much as fourteen fold by body fluids without removing their growth inhibition of *Staphylococcus aureus*.

In order to maintain a low water activity, sucrose can be added at four or six hourly intervals to the wound, without replacing the original sucrose. This method was used by Trouillet et al²¹ and Quatraro et al²² who used it to ensure that the water activity at the wound surface remained sufficiently low to maintain sterility. Chirife et al²³ indicated that a satisfactory concentration of sugar is 65%, corresponding to a water activity of 0.86. Forrest²⁴ considered that this concentration was too low because it would soon be diluted by exudate. To ensure an environment with a low bacterial contamination at the wound surface, it is better to apply a higher concentration of sugar. For example Anania et al²⁵ used 69%–74% sucrose in their povidone iodine pastes, Topham²⁶ used 87% sugar and Archer et al¹⁹ applied a sugar paste containing 81% sucrose to wounds on pigs. They concluded that 'sugar paste may be the treatment of choice for wounds that are traditionally treated with antiseptics'.

Debridement

The presence of a moist environment will facilitate wound debridement^{27,28}; sugar and sugar pastes will provide this. Martin et al²⁹ found that the moist environment produced by KY Jelly was as effective as enzymes in debriding necrotic sores. A number of authors have mentioned the debriding action of sucrose^{9,18,30,31,32} and occasionally surgical debridement is not required when it is used^{7,33}.

Promotion of Angiogenesis

Knutson et al³⁴ showed that sugar/povidone iodine pastes enhanced wound healing. Since the presence of sugar is expected to lower the oxygen available at the wound surface, it may be expected to aid wound healing, because Partridge³⁵ stated that an initial low oxygen pressure at the wound site causes macrophages to stimulate angiogenesis, causing an increase in tissue oxygen with increased epithelialization and collagen synthesis.

Middleton and Seal³⁶ recommended changing the sugar paste dressings on wounds at four hourly intervals to ensure that the sucrose concentrations remain high. It was admitted³³ that even twice daily dressing changes caused bleeding with reduction in the rate of healing. In the author's experience³⁷ 48 hourly dressing changes were adequate for rapid healing.

Occasionally, the patient may experience a 'burning' sensation when sugar or sugar paste are applied to a wound. This may be caused by the osmotic withdrawal of moisture from the wound by the sugar. This pain may be alleviated by spreading a thin layer of lignocaine gel on the wound prior to the application of sugar (personal communication).

The use of sugar on wounds may be preferable to the application of growth factors^{6,38–40} because Henry⁴¹ suggested that the latter may stimulate the growth of unrecognised tumours. Furthermore, Falanga⁴² stated that they were not highly effective in the treatment of leg ulcers.

Malodour

Thomlinson¹⁵ recommended that icing sugar be sprinkled onto breast ulcers every 12 hours to reduce odours. Normally icing sugar is not recommended for wounds because it contains a decaking agent. But, provided the wound is small so that significant quantities of decaking agent do not accumulate in it, icing sugar may be used. This was exemplified by Tovey³, who used a sugar paste containing icing sugar on diabetic foot ulcers. Others have shown that sugar and sugar pastes deodorise^{30,33,43,44}.

Molan² stated that the deodorisation of offensive odours by honey can be expected as a result of antibacterial action. He suggested that, by using the dextrose (glucose) in honey, in preference to amino acids, bacteria would cease to produce ammonia, amines and sulphur compounds which cause malodour. Thomas et al⁴⁴ gave more details of these odour-producing chemicals. Another explanation could be that the low water activity, produced by the high monosaccharide content of honey, prevents the growth of bacteria present on the wound surface. A similar explanation could apply to the deodorising action of the disaccharide sucrose when applied pure, or in paste form, to wounds. Provided the water activity of the sugar (sucrose) at the wound surface does not rise above 0.9, corresponding to a concentration of 60%¹⁸ the growth of most bacteria will be inhibited.

Overgranulation

The presence of a gum in a wound dressing restricts overgranulation. For example Young²⁸ found that a

hydrocolloid (Granuflex, ConvaTec Ltd, Uxbridge) reduced hypergranulation of wounds. Seal and Middleton³³ observed that, when granulation tissue was well established as the result of applying a sugar paste that did not contain any gum, the paste had to be replaced with an alginate, hydrogel or hydrocolloid dressing to complete epithelialisation. The author^{18,45} found that the presence of the adhesive povidone in sugar paste appeared to prevent hypergranulation. Lowthian and Barnett⁴⁶ suggested that sterculia (karaya) gum encouraged both normal granulation and good epidermal ingrowth. These examples indicate that the presence of an adhesive hydropolymer (gum) in sugar paste, may produce a matrix which encourages the growth of epithelial tissue and prevents scarring, in a similar manner to that achieved by hyaluronic acid^{47,48} and fibronectin⁴⁹.

Contraction and Scarring

Topham^{26,37} found wounds treated in Zanzibar with sugar pastes containing povidone, as povidone iodine, healed without contraction or scarring. The most striking example of their absence was the burns on the hands of the boy K²⁶. He had full use of his fingers as a result of sugar paste treatment, but horrendous contractions and some scarring on the dorsal surfaces of his hands, when the paste treatment ceased abruptly. From this it may be surmised that sugar on wounds, with or without the presence of gum, regulates the rate of deposition of collagen and elastin⁵⁰ to prevent contractions and scarring.

Other Uses

In addition to its use on cavity³³, superficial wounds²² and burns²⁶, sugar has been used to treat necrotising fasciitis⁵¹, paraphimosis⁵², hiccups⁵³ and it was used on Jenny Pitman, the race horse trainer, to treat radiotherapy wounds after cancer treatment.

Summary and Conclusions

Sugar (sucrose) and sugar pastes are non-toxic healing agents that have been successfully used to treat wounds for many years and should be used for many more. Provided suitable concentrations of adhesive hydropolymers (gums)¹⁸ are present, sugar pastes should be suitable for treating fungating wounds, burns and cavity wounds with minimal contraction and scarring. This should mean that skin grafting is not required for many wounds which have been treated with these sugar pastes.

Address for correspondence

John Topham, 31 Elizabeth Gardens, Southsea, Hants PO4 9QZ.

References

- Engelsen SB, Peres S. Internal motion and hydration of sucrose in diluted water solution. *Journal of Molecular Graphics and Modelling* 1997; **15**(2): 122–131.
- Molan PC. The role of honey in the management of wounds. *Journal of Wound Care* 1999; **8**(8): 415–418.
- Tovey F. Honey and healing. *Journal of the Royal Society of Medicine* 1991; **84**(7): 479.
- Winter GD. Formation of the scab and the rate of epithelialization of superficial wounds in the skin of the young domestic pig. *Nature* 1962; **193**: 293–294.
- Thomas S. Wound management and dressings. London: Pharmaceutical Press, 1990.
- Clark RAF, Henson PM. The molecular and cell biology of wound repair. New York: Plenum Press, 1988.
- Chirife J, Herszage I, Joseph A, Kohn ES. In vitro study of bacterial growth inhibition in concentrated sugar solutions: microbial basis for the use of sugar in treating infected wounds. *Antimicrobial Agents and Chemotherapy* 1983; **23**(5): 776–783.
- Thomas S. Points from the post. *Dressings Times* 1991; **4**(1): 4.
- Szerafin T, Vaszily M, Peterffy A. Granulated sugar treatment of severe mediastinitis after open-heart surgery. *Scandinavian Journal of Thoracic & Cardiovascular Surgery* 1991; **25**(1): 77–80.
- Beading L. A bag full of sugar. Surgeons find that ordinary table sugar is a sweet adjunct to conventional deep wound healing. *Today's Surgical Nurse* 1997; **19**(3): 28–30.
- Dawson JS. The role of sugar in wound healing. A comparative trial of the healing of infected wounds using traditional gauze/antiseptic packing and granulated sugar, undertaken at an elective period at Kaganda Hospital, Uganda. *Annals of the Royal College of Surgeons of England* 1996; **78**(suppl 2): 82–85.
- Gebauer R, Hucin B, Tlaskal T, Kostelka M. Treatment of post operative mediastinitis with sucrose (Czech). *Rozhledy v Chirurgii* 1997; **76**(4): 196–199.
- Sugar and honey in the treatment of leg ulcers [Editorial]. *The Lancet* 1940; **1**(26): 1184.
- Archer H, Middleton K, Milledge J, Seal D. Toxicity of topical sugar. *The Lancet* 1987; **1**(8548): 1485–1486.
- Thomlinson RH. Kitchen remedy for necrotic malignant ulcers. *The Lancet* 1980; **2**(8196): 707.
- Loncin MC, Merson RL. Food engineering – principles and selected applications. London: Academic Press, 1979: 195–202.
- Noggle JH. Physical chemistry (2nd ed). London: Scott, Forseman & Co, 1989: 357–360.
- Topham J. What's new in wound treatment? – Not a lot! *Journal of Tissue Viability* 1994; **4**(3): 86–89.
- Archer H, Barnett S, Irving S, Middleton KR, Seal DV. A controlled model of moist wound healing: comparison between semi-permeable film, antiseptics and sugar paste. *Journal of Experimental Pathology* 1990; **71**: 169.
- Cooper RA, Molan PC, Harding KG. Antibacterial activity of honey against strains of *Staphylococcus aureus* from infected wounds. *Journal of the Royal Society of Medicine* 1999; **92**(6): 283–285.
- Trouillet JL, Chastre J, Fagon JY, Pierre J, Domart Y, Gibert C. Use of granulated sugar in the treatment of mediastinitis after cardiac surgery. *The Lancet* 1985; **2**(8448): 180–184.
- Quatraro A, Minei A, Donzella C, Caretta F, Consoli G, Guigliano D. Sugar and Wound Healing. *The Lancet* 1985; **2**(8456): 664.
- Chirife J, Scarmato G, Herszage L. Scientific basis for the use of granulated sugar in the treatment of infected wounds. *The Lancet* 1982; **1**(8271): 560–561.
- Forrest RD. Sugar in the wound. *The Lancet* 1982; **1**(8276): 861.
- Anania WC, Rosen RC, Wallace JA, Weinblatt MA, Gerland JS, Castillo J. Treatment of diabetic skin ulcerations with povidone-iodine and sugar. *Journal of the American Podiatric Medical Association* 1985; **75**(9): 472–474.
- Topham J. Sugar paste and povidone-iodine in the treatment of wounds. *Journal of Wound Care* 1996; **5**(8): 364–365.
- Bale S, Jones V. Wound care nursing. London: Bailliere Tindall, 1997: 59.

- 28 Young T. Use of a hydrocolloid in over-granulation. *Journal of Wound Care* 1997; 6(5): 216.
- 29 Martin SJ, Corrado OJ, Kay EA. Enzymic debridement for necrotic wounds. *Journal of Wound Care* 1996; 5(7): 310-311.
- 30 Cheillet N (producer). Sugar for wounds. Trust me I'm a doctor. BBC2 13.3.99 8pm.
- 31 Healing of cavity wounds [Editorial]. *The Lancet* 1991; 337(8748): 1010-1011.
- 32 Gordon H, Middleton K, Seal D, Sullens K. Sugar and wound healing. *The Lancet* 1985; 2(8456): 663-664.
- 33 Seal DV, Middleton K. Healing of cavity wounds with sugar. *The Lancet* 1991; 338(8766): 571-572.
- 34 Knutson RA, Merbitz LA, Creekmore AA, Snipes LG. Use of sugar and povidone iodine to enhance wound healing. Five years experience. *Southern Medical Journal* 1981; 74(11): 1329-1335.
- 35 Partridge C. Influential factors in surgical wound healing. *Journal of Wound Care* 1998; 7(7): 350-353.
- 36 Middleton KR, Seal D. Sugar as an aid to wound healing. *Pharmaceutical Journal* 1985; 235: 757-758.
- 37 Topham J. Experiences with sugar paste in Zanzibar. *Dressing Times* 1991; 4(3): 3-4.
- 38 Longaker MT, Adzick NS, Hall JL. Studies in fetal wound healing VII: hyaluronic acid stimulation activity distinguishes fetal from adult wound fluid. *Annals of Surgery* 1989; 210: 667-672.
- 39 Whitby DJ, Ferguson MLW. Immuniochemical localisation of growth factors in fetal wound healing. *Developmental Biology* 1991; 147: 207-215.
- 40 Gill D. Angiogenic modulation. *Journal of Wound Care* 1998; 7(8): 411-414.
- 41 Henry TD. Can we really grow new blood vessels? *The Lancet* 1998; 351(9119): 1826-1827.
- 42 Falanga V. Care of venous leg ulcers. *Ostomy/Wound Management* 1999; 45(Suppl. 1A): 33S-43S.
- 43 Haughton W, Young T. Common problems in wound care: malodorous wounds. *British Journal of Nursing* 1995; 4(16): 959-963.
- 44 Thomas S, Fisher B, Fram P, Waring M. Odour absorbing dressings: a comparative laboratory study. 7.4.98 World Wide Wounds <http://www.smtl.co.uk>
- 45 Topham JD. In a Zanzibar factory. *Pharmaceutical Journal* 1992; 249: 191-192.
- 46 Lowthian P, Barnett S. Sterculia for wound healing. *The Lancet* 1985; 2(8465): 1186.
- 47 Harris PA, di Francesco F, Barisoni D, Leigh IM, Navsaria HA. Use of hyaluronic acid and cultured autologous keratinocytes and fibroblasts in extensive burns. *The Lancet* 1999; 353: 35-36.
- 48 Hollander D, Stein M, Bernd A, Windolf J, Pannike J. Autologous keratinocytes cultured on benzyl ester hyaluronic acid membranes in the treatment of chronic full-thickness ulcers. *Journal of Wound Care* 1999; 8(7): 351-355.
- 49 Clark RAF. Overview and general considerations of wound repair. In: Clark RAF, Henson PM, editors. *The molecular and cell biology of wound repair*. New York: Plenum Press, 1988: 10-12.
- 50 Eisenbeiss MD, Peter FW, Klinik BS, Baktiari, Frenz C. Hypertrophic scars and keloids. *Journal of Wound Care* 1998; 7(5): 255-257.
- 51 Young T. Necrotising fasciitis - a case study approach. *Tissue Viability Matters*: 25th Conference of the Tissue Viability Society, Derby, 25/9/95.
- 52 Kerwat R, Shandall A, Stephenson B. Reduction of paraphimosis with granulated sugar. *British Journal of Urology* 1998; 82(5): 755.
- 53 Engelman EG, Lankton J, Lankton B. Granulated sugar as treatment for hiccups in concious patients. *New England Journal of Medicine* 1971; 285(26): 1489.

PRESSURE SORE STUDY DAY

+

Opening of the

Pressure Sore Information Service

21st November 2000

St George's Hospital, Blackshaw Road, London

Programme: 10.00-16.00

Introduction

Aetiology, prevention and classification of pressure sores

Opening of the PSIS

Local wound management of pressure sores

Conclusions

Cost £20 non-refundable

Lunch, tea and afternoon coffee will be provided

For further information contact Jean Hookway

0208 672 1255 bleep 6681